SECTION III.—FORECASTS AND WARNINGS.

FORECASTS AND WARNINGS, OCTOBER, 1917.

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[Dated: Weather Bureau, Washington, Nov. 17, 1917.]

INTRODUCTION.

Since the beginning of the forecast and warning service in the seventies it has been the rule, though not an invariable one, that this chapter in the MONTHLY WEATHER REVIEW—Forecasts and Warnings—shall be prepared by the official who was on active forecast duty during the month.

In all there have been about 20 different officials engaged at one time or another upon forecast duty. It needs no stretch of imagination to realize that 20 persons writing upon any subject without conscious effort to treat it systematically will produce as many divergent reports as there are writers. It has therefore seemed to the present writer that from the viewpoint of the forecasters themselves, the chapter in question should be prepared with a definite end in view and after a uniform plan. For example, it would seem desirable that the direct objects should be: (*a*) To form a concise account in narrative form of the forecasting activities of the bureau for the month; (*b*) to stimulate in forecasters and other officials a lively personal interest in that work; and, finally, (*c*) to acquaint educators and other persons with some of the details that are known only to forecasters themselves.

The plan.—Charts II and III, paths of anticyclones and cyclones, respectively, to serve as the basis of the discussion. Subordinate features appropriate for remarks are: (1) The pressure distribution in Alaska and the Pacific; (2) the character of the weather of the month as a result of cyclonic and anticyclonic control; (3) forecasts of the weather, and by weather is meant the occurrence or nonoccurrence of precipitation, changes in temperature above or below a certain limit, the direction and force of the winds, etc. These may be treated in a general paragraph or in detached paragraphs in connection with the cyclonic and anticyclonic control in each case; (4) warnings of all classes discussed with reference to the cyclonic or anticyclonic control.

WEATHER OF OCTOBER, 1917.

The weather of October, 1917, may be characterized as cold east of the Rocky Mountains with several periods of abnormally low temperature during which the earliest killing frost on record occurred at many places. West of the Rocky Mountains the temperature was somewhat above the seasonal average and very little precipitation occurred. In the Lakes Region, the Ohio Valley, and the Middle Atlantic and New England States, the low temperature was associated with much cloudiness and rain, a combination that resulted in disagreeable stormy weather in a month that is generally recognized as one of the most pleasant of the year.

PRESSURE OVER PACIFIC AND ALASKA.

Daily reports of pressure wind and weather are received by cable from two points in the Pacific, viz, Midway Island and Honolulu, Oahu. The pressure variations at these two placces during October, 1917, were only roughly synchronous and, indeed, at times they were opposite in phase. Midway pressures were uniformly higher than those of Honolulu and the amplitude of the variations was greater. Comparing Midway pressures with those of Dutch Harbor, Alaska, for example, the results for the month were mostly negative. It is evident that Alaska pressures should be classed as coastal and interior and that the distribution must frequently be opposite in phase over the two regions. From the 14th to the 22d, pressure was high in interior Alaska and to a lesser degree over the Canadian northwest and the east slope of the Rocky Mountains Region. During this time LOWS were passing eastward from the northeastern Rocky Mountains slope, followed closely by HIGHS, which moved rapidly southward over the Plains States. While the barometer fell at times along the Pacific Coast intense LOWS were wholly absent—see remarks of District Forecaster Willson, page 506.

HIGHS.

Origin of highs.—The HIGHS of the month originated, so far as can now be determined, probably over the Pacific Ocean immediately west of British Columbia, although the paucity of observations makes it impossible to fix, with any degree of accuracy, the actual origin of those HIGHS first observed in British Columbia and Alberta. This, however, seems clear: They did not originate in Alaska in October, 1917. Rather it would seem the appearance of a LOW in the vicinity of Sitka is a condition favorable to the early development of a HIGH in British Columbia or perhaps in Alberta. More observations and study of the problem is necessary before safe conclusions can be reached.

Eleven HIGHS have been plotted on Chart II (XLV–96). Among these numbers *II*, *IV*, *VI*, *VIII*, *X*, and *XI* are of special interest by reason of the strong southerly component in their movement. In general the direction of movement was east-southeast as may be seen by an inspection of Chart II: but the paths of those above mentioned both individually and collectively have a strong southerly component over the Plains States, coupled with an unusually rapid progression; in one case, that of No. *II*, the 24-hour movement (a. m. of 7th to a. m. of 8th) was about 900 miles, or at the rate of 38 miles per hour. This statement does not mean that the entire mass of air comprised within the crest of the HIGH advanced bodily southward at the rate of 38 miles per hour, but rather that the crest of the HIGH, which appeared on the morning of the 7th just north of Havre, Montana, appeared on the morning of the 8th at Dodge, Kans., about 900 miles to the southeastward. I prefer to believe that this transfer was brought about by some readjustment of the pressure of the atmosphere in the region between these two points. How such adjustment was brought about and at what level in the atmosphere it took place can not be definitely stated. Kite flights at Drexel, Nebr., indicate that the layer of cold air in front of a HIGH extends from 1 to 3 kilometers above the surface—rarely as high as 3 kilometers.

The forecasting significance of the movement or the readjustment, whichever it be considered, lies in the

changes in temperature involved. The change from relatively high to relatively low temperature was a physical phenomenon quite apparent to the senses whereas the change in pressure was probably not. Temperatures fell sharply in advance of the HIGH over a zone of irregular shape but extending at least 1,000 miles in a north-south direction. Some of the changes were:

Rapid City, S. Dak., from 42° to 24°.
North Platte, Nebr., from 42° to 24°.
Dodge City, Kans., from 54° to 28°.
Oklahoma, Okla., from 52° to 44°.
Dallas, Tex., from 68° to 54°.
San Antonio, Tex., from 70° to 66°.

The drop on the second day at San Antonio, Tex., was from 66° to 46° and for other points of southern Texas in proportion. A change to lower temperature may thus sweep southward at a speed of nearly 40 miles an hour. Similar changes were also experienced in connection with HIGHS *IV*, *VI*, *VIII* and *X*; the fall in connection with *VI* and *X* being more severe than in the others. Freezing temperature was recorded at San Antonio on the morning of the 30th, being the lowest October temperature of record there. The lowest October minimum temperature of record was quite generally observed on that date throughout Texas and Oklahoma, also in Arkansas, Missouri, and at Vicksburg, Miss.; the period of observations at the last named covering upward of half a century. A second significant fact in connection with the southward sweep of HIGHS was the absence of precipitation of consequence in the Plains States and the Southwest.

It is of particular interest to forecasters to note that the one of the meteorological condition favorable to a southward sweep of HIGHS over the Plains States is a trough of low pressure extending from, say, the upper Mississippi Valley to Texas. It will be seen from Chart III (XLV–97) that the centers of October LOWS moved far to the north of the Gulf States; however, each LOW was associated with a more or less pronounced trough that extended far to the southwest and some of them were of the V-type with the apex of the V extending into northeastern Colorado. Such pressure configurations are quite favorable to the southward advance of HIGHS and lower temperature. In one case, that of HIGH No. *IV*, the HIGH advanced eastward almost as rapidly as southward and to that fact was due the clearing of the weather in the Ohio Valley on the 13th while the center of the LOW was still over eastern Lake Huron.

The turning of HIGHS to the northeast after reaching the latitude of Oklahoma or north Texas is perhaps a natural consequence of the more rapid eastward drift in northern than in southern latitudes. When a trough of low pressure is passing eastward over the Plains States the northern end moves more rapidly than the southern, and as a result there is a tendency toward the formation of secondary centers of low pressure in the southern end of the trough. These are generally of little significance in forecasting except that they favor a direct southward sweep of the high rather than an eastward sweep. So it generally happens that HIGHS in the Missouri Valley often make a long detour to the south before turning to the northeast. How much of this movement is due to gravitational effect can not of course be easily evaluated but it must be considerable. The winds on the front of HIGHS moving southward over the Plains States are almost invariably fresh to strong and due north in direction. When the falling temperature and high winds are attended by snow the term "blizzard" is used to describe the resulting weather.

Northers in the Canal Zone.[1]—The conditions favorable to the development of a "Norther" over the western Gulf of Mexico and the western Caribbean were present on several occasions during the month, particularly on the 23d and again on the 30th, but it was not until November 3 that a "Norther" in full force was experienced in the Canal Zone. For this reason the track of the HIGH which produced it, No. *XI* of Chart II, is of special interest. While the warnings were issued in November the HIGH had its origin over the northern part of the Great Basin on the 30th. On that date pressure was 30.30 inches and slightly over throughout the Great Basin. Pressure fell slightly on the afternoon of that date and rose somewhat on the 31st. Then began a slow movement to the southeast which brought the crest of the HIGH to the northern part of the East Gulf States by the morning of November 3 with a gradient for northerly winds over the Gulf of Mexico, the Caribbean Sea, and the Greater Antilles, and an increase in central pressure from 30.40 to 30.60 inches. The increase in central pressure, as above, seems to indicate strong nocturnal radiation within the HIGH.

Subsequent mail reports show that there were strong winds over the western Gulf of Mexico on the dates following the warnings for Northers. On October 23, 1917, the steamer *Olympic* was wrecked about 60 miles off Frontera, Mexico, in a strong northerly gale and heavy sea. The morning report of October 30 from Vera Cruz gives a wind velocity of 38 miles per hour from the northwest.

LOWS.

The paths of eleven LOWS have been platted on Chart III and one which moved from the upper Lakes to the mouth of the St. Lawrence during the first few days of the month was platted on the September chart. The LOWS may be classed according to place of origin as follows:

Alberta, 7; Northern Rocky Mountain, 2; Middle Rocky Mountain, 1; and Atlantic, south of the Carolina coast, 1.

The majority of these LOWS passed eastward or northeastward without developing unusual features.

The two Northern Rocky Mountain LOWS, *VII* and *X* of Chart III, were attended by high temperature and quite general thundershowers east of the Mississippi. The temperature fell sharply in the rear of both these LOWS. The contrasts in weather on the two sides of the LOW were striking, viz, thundershowers and warm weather on the east and snow with low temperature on the west.

As Alberta LOW No. *VIII* reached the upper Lakes Region, pressure began to rise at the center and a strong anticyclone appeared in its rear, with steep gradients for northerly winds over the Dakotas. As the center passed across the Great Lakes the central pressure continued to rise and the expected steep gradients for northwesterly winds did not materialize over the Lakes, although northwest gales were experienced in the upper Mississippi and lower Missouri Valleys. When the center of the LOW had reached the upper Ohio Valley with a central pressure of 30.10 inches, on the morning of the 23d, the disintegration of the LOW seemed imminent. On the afternoon of the 23d, however, pressure fell rapidly over the Middle Atlantic States, with a maximum fall over southeastern Virginia, and on the 8 p. m. map of that date a depression of 29.90 inches appeared in that region. This depression developed into a severe storm of wind and rain during the

[1] Northers on the Texas and Gulf coasts are discussed in this REVIEW, 1893, 21: 226, 332, 363, and 1898, 26: 446.

next 12 hours, and moved northward on the 24th, passing down the St. Lawrence Valley on the 25th (see *VIII* of Chart III).

The second Northern Rocky Mountain LOW, *X* of Chart III, appeared in northwestern Montana on the morning of the 27th; reached the Great Lakes by way of Wyoming, Colorado, Kansas, Missouri, and Iowa two days later; passed down the St. Lawrence Valley on the 30th; and caused moderate to fresh southerly shifting to westerly gales along the Atlantic Coast north of the Carolinas on the 30th.

WARNINGS.

Frost.—Warnings of frost or freezing temperature were issued for one part or another of the Washington forecast district on 11 days in October, 1917.

The lateness of the Spring of 1917 caused much speculation as to whether or not an early autumn would be experienced. The record of the month leaves no uncertainty as to the fact that killing frost and freezing temperatures occurred much earlier than usual in many parts of the country.

Gales.—The month was unusually stormy, particularly on the Great Lakes and on the Atlantic Coast north of the Virginia Capes. Warnings of strong winds to moderate gales on the Great Lakes were ordered on 15 dates. Not all of the storms were severe, nor did they attain equal intensity on all the lakes. Storms were more frequent on Lake Superior than on the remaining lakes, and the storm of October 25–26 did not reach the Upper Lakes. Warnings were issued for Atlantic Coast stations on 10 dates. The display on the four days, October 9, 10, 11, and 12, was for a coast storm that at no time until the 11th approached close to shore. The steamship *New Orleans* encountered this storm off the Virginia Capes. She had an accident to the 20-inch suction pipe connected to the condenser and before repairs could be made foundered and sank.

The storms of October 24–25 and 29–30 were the most severe of the month, both causing considerable loss to beach property along the Middle Atlantic and New England Coast.

Reports of the forecasting activities at forecast districts outside of Washington, D. C., follow.

WARNINGS FROM OTHER DISTRICTS.

Chicago (Ill.) forecast district.—October, 1917, was characterized by remarkable activity in the development and movement of disturbances from the Northwest. The total number for the month, with a 12-hour pressure fall exceeding 0.33 inch, was 13, mostly of the Alberta type. The average greatest 12-hour pressure fall for the 13 storms was 0.49 inch. This unprecedented activity was in striking contrast with the conditions which obtained during October in the years 1900–1916, inclusive, during which time there was a total of 59 storms from the far Northwest, or an average of 3½ per month, with greatest 12-hour pressure fall exceeding 0.33 inch. The greatest number for any previous October was 6, and in 1900 there was none. Not only was the number of these disturbances large and their rate of movement much in excess of the average, but several of them moved far south of the normal path for storms of the Alberta type, crossing Minnesota and Wisconsin and causing much stormy weather in those States as well as in northern Illinois and eastern Iowa.

Except in the northern Rocky Mountains Region the mean temperature for October was much below normal in this forecast district, and was the lowest for that month at practically every station. At Duluth the record mean temperature was lowered by 7 degrees.

Frost warnings were issued for Minnesota and portions of the Dakotas on October 4; for the upper Mississippi Valley and western Lake region on the 5th; for western South Dakota on the 6th; for the middle and northern portions of the district on the 7th; for Illinois and portions of Missouri and Wisconsin on the 8th and 10th; for northwestern Missouri, southeastern Wyoming, and Kansas on the 11th; and warnings of freezing temperature for Illinois on the 12th. These warnings were well verified, as a rule, and by the 13th killing frost had occurred over the entire district.

On the morning of the 21st a disturbance was centered over North Dakota with a secondary disturbance apparently developing over eastern Colorado, while a marked rise in pressure with a corresponding temperature fall was shown at Edmonton and Calgary, Alberta. These conditions being quite favorable for the building up and rapid southeastward advance of a high-pressure area, attended by much colder weather over the northeastern slope of the Rockies, cold-wave warnings were issued for Montana east of the Divide, northeastern Wyoming, and the extreme western portions of the Dakotas. The afternoon map of the same date showed a well-developed high-pressure area over Alberta and a secondary depression over eastern Colorado, and cold-wave warnings were extended to cover the remainder of the Dakotas and Wyoming, Nebraska, western and central Kansas, northwestern Minnesota, and western Iowa. On the following morning warnings were issued for southern Iowa, northern and western Missouri and Kansas. These warnings were fully verified at some stations and partially at others as far east as the Missouri River.

A disturbance which developed over eastern Washington during the night of the 26th–27th moved rapidly southeastward to Colorado, thence eastward to southwestern Missouri, where it was central on the evening of the 28th. Following this disturbance an area of high pressure of great magnitude built up over Alberta and advanced rapidly southeastward over the Rocky Mountains Region. It was attended by a cold wave, severe for the season, in the Rocky Mountains Region and from the southern Plains States eastward, temperatures of 0° F. and below being reported in Wyoming on the 29th. Warnings were issued well in advance of the cold wave for practically the entire region affected.—*Chas. L. Mitchell, Assistant Forecaster.*

New Orleans, La., forecast district.—An exceptionally large number of severe frosts and cold waves occurred in this district during October, 1917. The cold waves in this district during October of this year exceeded the total number that have occurred here in that month during the past 15 years. Warnings for unseasonably severe weather conditions were issued on four dates.

The weather conditions as shown by the 8 a. m. map of October 8 indicated warnings for frosts in this district, 10 days to two weeks earlier in the season than such general frosts had previously occurred.

Frost warnings were issued as follows: On Monday, October 8, for Tuesday morning, for Louisiana (interior); for Arkansas, south, heavy frost north, and freezing northwest; for Oklahoma, freezing; for western Texas, frost, except southwestern portion; for eastern Texas, frost interior.

Special frost warnings was issued on Monday morning, October 8: Louisiana, northern portion of the sugar and trucking region Wednesday morning.

Freezing or heavy to killing frost prevailed over Oklahoma and Arkansas; and frost occurred nearly to the Gulf coast, being heavy over the northern portions of Louisiana and Texas Tuesday morning, October 9.

On Wednesday morning, October 10, heavy to killing frost occurred over the interior of Louisiana; minimum temperatures ranged from 25° over the interior to 40° near the coast, with frost well southward into the sugar and trucking region.

The warnings for these unprecedented frosts were issued 24 to 48 hours in advance. The value of food crops gathered and saved as a result of these warnings was large; there were, however, large crops over the northern portion of the district which could not be protected, such as rice and cotton, and the injury to these crops amounted to several millions of dollars.

The weather conditions as shown by the 8 p. m. map of October 17 and the 8 a. m. map of the 18th, indicated warnings for an exceptionally severe cold wave for the season and heavy frosts. Warnings were issued as follows:

Wednesday, October 17 (p. m.): For Oklahoma and the Texas Panhandle, cold wave; the temperature will be below freezing in Oklahoma and 20° to 26° in the Texas Panhandle Friday morning.

Thursday, October 18 (a. m.): For Louisiana, freezing in north portion and frost in the sugar and trucking region by Saturday morning; for Arkansas, cold wave and freezing in northwest portion; for Oklahoma, cold wave with temperature below freezing; for northern portion of West Texas temperature will be below freezing; for East Texas, freezing northwest and north-central portions Friday morning.

Friday, October 19 (a. m.): For Louisiana, heavy frost nearly to coast; for Arkansas, heavy to killing frost; for East Texas, frost nearly to the coast.

The cold wave and freezing temperatures occurred Friday morning as forecast. Heavy to killing frost occurred Saturday morning in Arkansas, heavy frost in Louisiana nearly to the coast, with the temperature 32° to 36° in the sugar and trucking region, and light to heavy frost in the interior of Texas.

Warnings were issued on the morning of October 21: For Arkansas, heavy frost; for Louisiana, frost nearly to coast, heavy in the interior; for eastern Texas, heavy frost in north and frost in southern portion nearly to the coast, except in the lower Rio Grande Valley.

Frost occurred on the morning of the 22d as forecast.

The weather map of October 22 indicated the severest weather conditions for the season that had occurred so early in the season in several years. As seed cane had not been put down, freezing weather warnings were issued, and extended 48 hours in advance for the sugar and trucking regions, as follows:

Monday, October 22 (a. m.): For Oklahoma, cold wave with temperature 22° to 26° Tuesday morning; for Arkansas, cold wave at Bentonville; for eastern Texas and Louisiana, freezing in the northern portion of the sugar and trucking regions Wednesday morning; seed cane should be put down.

Cold-wave warnings were issued at night for Shreveport, Palestine, Dallas, Fort Worth, Taylor, and Abilene.

Tuesday, October 23 (a. m.): For Wednesday morning—Arkansas, freezing; Louisiana, frost to coast, freezing in the interior with temperatures of 29° to 32° in the northern portion of the sugar and trucking region; for eastern Texas, frost to coast, except in lower Rio Grande Valley; freezing in the interior, with temperature 30° in the northern portion of the sugar and trucking region; cold wave at Houston and Port Arthur.

The cold wave occurred on the morning of the 23d in Oklahoma and northwestern Arkansas, and the temperature fell about 20 degrees over the interior of Texas and Louisiana, and the cold-wave warnings were partially verified. On Wednesday morning, the 24th, freezing temperatures prevailed southward nearly to the Gulf coast, with the temperature 27° to 35° in the northern portion of the sugar and trucking regions of Louisiana and Texas.

If the warnings had not been issued 48 hours in advance of this freeze, and sugar planters advised to put down seed cane, many planters would have been without seed cane for planting next year's crop, and the sugar output would have been materially reduced. No such low temperatures had occurred in the sugar and trucking regions as early in the season in previous years, and this warning with its advice proved an important factor in the conservation of an important food product for the coming year.

The 8 a. m. weather map of October 28 indicated severe weather conditions for this district, and warnings were issued for agricultural and live-stock interests, as follows:

Sunday, October 28 (a. m.).—For Oklahoma: Snow to-night or Monday; cold wave; temperature will be 26° to 30° Monday morning; strong northwest winds. For the northern portion of western Texas, probably snow; cold wave; temperature will be 24° to 28° Monday morning. For the northwestern portion of eastern Texas, cold wave at Abilene; freezing Monday morning.

Cold-wave warnings were extended, on the 8 p. m. map, over Arkansas, eastern Texas to the coast, and northern Louisiana, and warnings for freezing in the sugar and trucking region of Texas and Louisiana on Tuesday morning.

Snow fell in Oklahoma and the northern portion of west Texas, and the cold waves forecast for Monday morning occurred.

The 8 a. m. weather map of Monday, October 29, indicated that the lowest recorded October temperatures would occur in this district. Cold-wave warnings were extended to the coast, and the following warnings for unprecedented low temperatures for the season, to occur on Tuesday morning, October 30, were given the widest possible distribution.

Oklahoma: Temperature will be 10° to 18°.

Arkansas: Temperature will be 18° to 24° in the northern and 24° to 26° in the southern portion.

Eastern Texas: Temperature will be 24° to 30° in northern portion; cold wave in southern portion, except on west coast, with temperature 28° to 32° in sugar and trucking region.

Louisiana: Cold wave; temperature will be 24° to 30° in northern portion, 27° to 32° in the sugar and trucking region, and 38° to 44° at New Orleans.

On account of the large acreage of sugar cane standing and subject to severe injury from such temperatures, of Irish and sweet potatoes and other matured crops in the fields at this season of the year, and because growers previously had not experienced such low temperatures as these forecasts called for, the warnings for Louisiana and eastern Texas were supplemented by the following special admonition:

"Vegetation should be protected and matured crops housed."

Temperatures on Tuesday morning, the lowest of record for October over the greater portion of the Louisiana district, were: Oklahoma, 14° to 18°; Arkansas, 22° to 26°; eastern Texas, 20° to 29° over the interior, 27° to 32° in the sugar and trucking region, and 40° to 41° along the coast line; Louisiana, 26° to 30° over the interior, 28° to 32° in the sugar and trucking region, and 40° at New Orleans.

The weather map for Tuesday morning, October 30, indicated that conditions would favor intense radiation in the sugar and trucking region Tuesday night, and warnings were repeated for Louisiana, advising that the temperature would be 26° to 30° in the sugar and truck-

ing region Wednesday morning, with the special admonition, "Continue protection of crops." The temperature in the sugar and trucking region of Louisiana Wednesday morning was 24° to 32°, being generally about 27°.

The windrowing of cane was pushed, and notwithstanding that the injury to the crop will reduce the output of sugar nearly one-fourth, the warnings enabled planters to take action which prevented the loss of half the crop. Thus the warnings enabled the saving of one-fourth the entire crop, and as the crop of 1916 was worth $36,642,240, this shows that the value of the sugar crop saved by these warnings will amount to several million dollars. Nearly half the Irish and sweet potato crops and many of the smaller matured vegetable crops were saved as a result of the warnings given. The great saving of food supplies as a direct result of the advices given by the Weather Bureau in this instance can hardly be estimated.

Weather warnings were issued for rice and alfalfa interests for 84 hours in advance on October 3, 4, 5, 9, 10, 11, 16; and for 60 hours in advance on the 2d, 6th, 8th, 12th, 13th, 15th, 19th, 31st. All these warnings were verified.

Fire-weather warnings were issued on the 22d and 28th: weather and winds occurred as forecast.—*I. M. Cline, District Forecaster.*

Denver forecast district.—The weather was exceptionally dry, except in north-central Colorado, where frequent rain or snow fell. Several regular observing stations in the district reported no appreciable precipitation. The month was marked by extremes of temperature, a severe cold wave occurring on October 29, with temperature readings in Colorado lower than ever before recorded in that State in October; hot weather prevailed in southwestern Arizona on the 5th and 6th, when the highest temperatures of record at Phoenix for those dates, 104°, was reached.

Frost warnings were issued for considerable areas in Colorado and New Mexico on the 7th, 8th, 9th, 11th, 13th, and 14th, and were generally fully verified.

Fire-weather warnings were issued on several dates and were verified in localities, notably on the 17th, when the fire-weather station on the western slope in Colorado reported a 24-hour wind movement of 800 miles.

Warnings of freezing temperature or killing frost were issued for Colorado, Utah, northern New Mexico, and northern Arizona on the morning of the 17th. The warnings were fully verified. Similar warnings were repeated for the same area the following morning and extended to include southeast New Mexico. Freezing temperatures again occurred and killing frosts were reported at Salt Lake City, Santa Fe, and as far south as Roswell, N. Mex. The temperature fell to 28° in eastern New Mexico and was much lower in northwest New Mexico.

Another anticyclone having overspread the northern Rocky Mountain region on the morning of the 20th, freezing temperatures were predicted for Colorado. Freezing temperatures occurred in the early part of the night. On the morning of the 21st warnings of decidedly colder weather, with temperatures considerably below the freezing point, were issued for north-central Colorado. By the evening of the 21st an anticyclone was spreading southward over Montana, and cold-wave warnings were issued for eastern Colorado. At this time temperatures were well above 60°. On the 22d temperatures were 20 to 30 degrees lower in eastern Colorado and considerably below the freezing point by night. On the morning of the 22d freezing-temperature warnings were extended to cover eastern New Mexico, and were verified.

A cyclone of marked intensity appeared over western Montana at 6 a. m. on the 27th and moved southeastward to Idaho by the evening of the 27th, when an anticyclone covered Alberta. Cold-wave warnings were issued on the evening of the 27th for eastern Colorado, with advices of decidedly colder weather. At 6 a. m. Sunday morning, the 28th, cold-wave warnings were extended to western and southern Colorado, northeast Arizona, and southwest Utah, with the advice that decidedly colder weather was indicated. Notice of much colder weather was also sent to Salt Lake City. The warnings were timely, as decidedly colder weather overspread the greater part of the district. In a large part of Colorado the temperatures on the morning of October 29 were lower than ever before recorded in Colorado in October. As a result of the warnings of the 27th and 28th, apple picking was rushed and picked fruit, potatoes, etc., that had been dug and were exposed in the fields were placed in storage or gathered in piles in the fields and covered. Some were lost, however, on account of the scarcity of labor and it is estimated that 5 per cent of the potato crop was frozen in the ground. Fortunately, by far the greater portions of the fruit and potato crops had been gathered before the freeze. At 6 p. m. of the 28th cold-wave warnings were extended to include eastern New Mexico. The following morning temperatures were much lower in New Mexico, but were still several degrees above the previous low-temperature records in that region.—*Frederick W. Brist, Assistant Forecaster.*

San Francisco forecast district.—The controlling features of the weather in this district during the month, were the frequent recurrence of high pressure areas over the Plateau and Rocky Mountain regions and the persistency off the north Pacific coast of the Pacific Ocean permanent HIGH. This distribution of pressure caused the depressions from the north Pacific to pass eastward at a high latitude. The result was but little precipitation west of the Rocky Mountains and south of the international boundary, nearly all of it being confined to the western portion of Washington. The month was one of the driest Octobers on record in the Pacific Coast States.

Southeast storm warnings were issued on the 1st, from the mouth of the Columbia River north. Small-craft warnings on the 8th for the Strait of Fuca. Northwest warnings on the 27th, at the Strait of Fuca and mouth of Columbia River with small craft warnings at other Washington stations; and southeast warnings at the Strait of Fuca with advisory at other northern stations except Marshfield on the 28th. The warnings were but partly verified as the storms moved inland at a higher latitude than was expected.

Warnings of heavy to killing frosts were issued on the 16th, 17th, and 18th for Washington, Oregon, and Idaho, and killing frosts occurred except near the coast.

Fire-weather warnings were issued in California on the 3d, 17th, and 25th, and were justified.—*G. H. Willson, District Forecaster.*

551.515 (763)

TROPICAL HURRICANE OF SEPTEMBER 27-28, 1917, IN SOUTHEASTERN LOUISIANA.

By RAY A. DYKE, Assistant Forecaster.

[Dated: Weather Bureau Office, New Orleans, La., Oct. 13, 1917.]

The tropical storm that occurred during the last week of September, 1917, was of more than ordinary extent and severity, as appeared when the western segment of the hurricane passed over extreme southeastern Louisiana on the 28th.